

REMARKS

Claims 40, 56, 58, 67 and 69-75 are presently pending in this application. Claims 40, 64-67, 74 and 75 have been amended in this paper to clarify certain aspects of these claims, and claims 57 and 68 have been cancelled. The undersigned representative would like to thank Examiner Leader for indicating that claims 60-63 and 70-74 are allowable if rewritten in independent form, and also for holding an informative telephonic interview on 19 October 2005. In the Office Action dated 5 May 2005, the claims were rejected as follows:

(A) Claims 40 and 56-75 were rejected under 35 U.S.C. § 112, first paragraph.

(B) Claims 40, 56, 58, 59, 64-67, 69 and 75 were rejected under 35 U.S.C. § 103 over either (a) U.S. Patent No. 5,000,827 issued to Schuster et al. ("Schuster") or (b) U.S. Patent No. 4,466,864 issued to Bacon et al. ("Bacon") in combination with U.S. Patent No. 5,168,887 issued to Thompson et al. ("Thompson") and U.S. Patent No. 5,447,615 issued to Ishida ("Ishida").

(C) Claims 57 and 68 were rejected under 35 U.S.C. § 103 over either Schuster or Bacon in combination with Thompson, Ishida and U.S. Patent No. 5,078,852 issued to Yee et al. ("Yee").

A. Response to Section 112 Rejection

Claims 40 and 56-75 were rejected under 35 U.S.C. § 112, first paragraph, on the grounds that the specification does not reasonably convey to one skilled in the art that the inventors possessed the claimed invention at the time the application was filed. More specifically, the phrase "the electrical contacts have a portion inclined toward the processing plane" in claim 40 was held to be unsupported by the specification. The specification, however, supports this language because an electrode with a first portion mounted to the workpiece holder and a second portion projecting from the first portion upwardly toward the processing plane is disclosed. A portion of the electric contacts are thus inclined toward the workpiece processing plane (see Figures 24-28).

Although the applicants believe that the rejected version of claim 40 complied with Section 112, this claim has been amended such that the workpiece holder has electrodes with first portions mounted to the workpiece holder and second portions projecting from the first portions upwardly toward the processing plane such that the second portions have tips that bear against a peripheral region of the plating surface of the workpiece. The first and second portions of the electrodes are also spaced apart from the peripheral edge of the workpiece such that the electrodes only contact the plating surface of the workpiece. One embodiment of the claimed electrode structure is shown in the originally filed Figures 24-28 and described in the originally filed text at pages 50, 51, 54, 57, 60 and 62. Therefore, the rejection of claims 40, 56, 58-66, 67 and 69-75 under Section 112 should be withdrawn.

B. Response to Section 103 Rejection—Schuster or Bacon in Combination with Thompson and Ishida

Claims 40, 56, 58, 59, 64-67, 69 and 75 were rejected under 35 U.S.C. § 103 over the combinations of (a) Schuster, Thompson and Ishida, or (b) Bacon, Thompson and Ishida. For the reasons explained below, the cited combinations of references fail to disclose or suggest all of the features of claim 40, and there is no suggestion to combine Thompson and Ishida with either Schuster or Bacon to come up with the claimed combination of features.

1. Claim 40 is Directed to an Apparatus Including a Rotatable Workpiece Holder With Electrodes Having a First Portion Mounted to the Workpiece Holder and a Second Portion Projecting From the First Portion Upwardly Toward a Processing Plane Such That the Electrodes Only Contact a Plating Surface of the Workpiece

Claim 40 is directed toward a workpiece processing apparatus having a fluid cup with an upper rim forming an overflow weir, an electrode in the fluid cup to facilitate electrochemical processing of a plating surface of a workpiece, and a head assembly having a rotor and a workpiece holder. The rotor rotates about an axis, and the workpiece holder is attached to the rotor. The workpiece holder is also configured to hold the workpiece so that the plating surface faces downward in a processing plane,

and the workpiece holder includes a plurality of electrodes. The electrodes include first portions mounted to the workpiece holder and second portions projecting from the first portions upwardly toward the processing plane such that the second portions have tips that bear against a perimeter portion of the plating surface of the workpiece. The first and second portions of the electrodes are also spaced apart from a peripheral edge of the workpiece such that the electrodes only contact the plating surface of the workpiece.

Apparatus in accordance with claim 40 are useful for plating materials onto the front face of a workpiece to form very small features. One advantage, for example, is that the electrodes are configured to electrically contact a seed layer or other conductive layer on the plating surface (e.g., front face) of a workpiece without contacting the edge of the workpiece to electroplate material onto the plating surface of the workpiece. As a result, apparatus in accordance with claim 40 are capable of filling trenches, vias and/or other small features to form metallized structures on the front surface of a semiconductor wafer or other type of workpiece.

2. The Schuster, Thompson and Ishida References

Schuster is directed toward a method and apparatus for electroplating metallized bumps on predetermined terminal areas of a substrate. Referring to Figures 3A-3C of Schuster, this reference discloses plating a metallized bump (e.g., layers 14 and 15 in Figure 3C) onto the top of the metal terminal 19 (Figure 3B) within a hole 18 in an oxide layer 38 (Figure 3A). Schuster performs this process with an electroplating apparatus having several wafer support members 51 mounted to a ring or collar around the periphery of a cup 20. (Column 4, lines 50-55.) The wafer support members 51 in Schuster do not rotate. To plate the metallized bumps on the top of the terminals, Schuster further discloses applying an electrical potential to the backside of the wafer (i.e., wafer contact 30 shown in Figure 7). Schuster expressly discloses that "wafer contact 30 may take the form of a silver-clad nickel element which rests upon or is affixed to the upper surface of wafer or substrate 3." (Schuster, column 4, lines 50-52.) Schuster accordingly discloses a fixed workpiece holder (i.e., non-rotating) and backside electrical contacts.

The primary purpose of Schuster is to "solve the problem of 'edge effect' by selectively altering the metallic ion concentration of the electroplating solution near the edge(s) of the wafer substrate." (Column 2, lines 59-63.) Schuster further discloses achieving this purpose by optimizing the flow characteristics to create turbulent regions at the periphery of the workpiece. The flow characteristics, more specifically, are optimized by controlling (a) the distance between the wafer and the cup and (b) the difference between the diameter of the cup and the diameter of the wafer. Therefore, Schuster teaches that it is important to provide selected levels of turbulence in the peripheral region of the plating surface.

Thompson is directed to a system having a rotatable head with a workpiece holder that holds a surface of the workpiece face down. As shown in Thompson, the workpiece holder engages the peripheral edge of the workpiece.

Ishida is directed toward a plating device that has a plating tank and a head above the plating tank. The purpose of Ishida is to provide an electrical connection with a conductive layer underneath a film of resist without removing the resist. (Column 1, line 64 to column 2, line 3.) Referring to Figure 1 of Ishida, this reference teaches a plating device having a tank 1, a support surface 12 fixedly attached to the rim of the tank, and a plurality of electrodes 17 fixed to the tank 1. (Column 4, lines 24-51.) In operation, an air bag 7 presses a workpiece against the electrodes to pierce the resist film. Notably, the workpiece remains stationary during plating and the electrodes 17 are fixed to the tank 1.

3 The Combination of Schuster, Thompson and Ishida Fails to Disclose or Suggest, *inter alia*, a Rotatable Workpiece Holder With Electrodes Having a First Portion Mounted to the Workpiece Holder and a Second Portion Projecting From the First Portion Upwardly Toward a Processing Plane Such That the Electrodes Only Contact a Plating Surface of the Workpiece

Amended claim 40 is patentable over the combination of Schuster, Thompson and Ishida because this combination references fails to disclose or suggest several features of claim 40. For example, these references do not disclose a "rotatable"

workpiece holder with "electrodes having first portions mounted to the workpiece holder and second portions projecting from the first portions upwardly toward the processing plane such that the second portions have tips that bear against a peripheral region of the plating surface of the workpiece." First, Schuster merely discloses a backside electrode that contacts the backside of the wafer instead of "bearing against the plating surface" as set forth in claim 40. Second, Ishida discloses electrodes that are fixed to the tank so that they can pierce a layer of resist. As such, neither Schuster nor Ishida discloses a rotatable workpiece holder with electrodes having first portions mounted to the workpiece holder and second portions projecting from the first portions upwardly toward a processing plane such that the electrodes only contact a plating surface of the workpiece. Thus, the combination of Schuster, Thompson and Ishida does not disclose or suggest at least one feature of claim 40.

Amended claim 40 is further patentable because any attempt to combine Thompson and Ishida with Schuster to come up with the claimed combination of elements set forth in amended claim 40 would necessarily be based on impermissible hind-sight reasoning. As stated in C.R. Bard Inc. v. M3 systems Inc., 48 U.S.P.Q.2d, 1232 (Fed. Cir. 1998), "it is insufficient that prior art shows similar components, unless it also contains some teaching, suggestion, or incentive for arriving at the claimed structure." As stated by the Court in re Sernaker, 217 U.S.P.Q. 1, 6 (Fed. Cir. 1983) in discussing an earlier case, "The lesson of this case appears to be that prior art references in combination do not make an invention obvious unless something in the prior art references would suggest the advantage to be derived from combining their teachings." The applicants submit that, as in the C.R. Bard and Sernaker cases, the claimed invention in the present case is nonobvious over the references because there is nothing in the references to suggest that an improvement in plating into trenches or other small features using a seed layer on the plating surface might be achieved by combining their teachings. Moreover, there is nothing in the references to suggest that the improvement achieved by the combination of a rotatable workpiece holder with electrodes having first portions mounted to the workpiece holder and second portions projecting from the first portions upwardly toward a processing plane such that the

electrodes only contact a plating surface of the workpiece might be achieved by combining their teachings.

To avoid an incorrect conclusion of obviousness, the Examiner must view the invention as a whole and each of the references as a whole. There are many cases that establish the requirement that the invention must be viewed as a whole and that each of the references must also be viewed as a whole when the issue of nonobviousness is confronted. In particular, the Examiner is not permitted to disregard disclosures in the references that diverge from and teach away from the invention at hand, W.L. Gore & Associates, Inc. v. Garlock, Inc., 220 U.S.P.Q. 303, 311 (CAFC 1983). In the present case the problems addressed by the Schuster reference are different from the problems addressed by (a) the Thompson and Ishida references, and (b) the present invention. More specifically, Schuster is directed toward creating controlled regions of turbulence at the perimeter of the workpiece and Ishida is directed toward electrically connecting power to a layer under a resist film without removing the resist. In either case, the undersigned contends that these references have non-rotating heads for a purpose. There is no suggestion to use a rotating head in Schuster because to do so would only complicate the flow characteristics of the turbulence across the wafer. There is also no suggestion to use the contacts of Ishida with a rotating head because Ishida's contacts are fixed to the tank and rotating the workpiece across the fixed needle-like contacts of Ishida would likely damage both the contacts and the workpiece. Therefore, when taken as a whole, there is no suggestion to combine Thompson and Ishida with Schuster to come up with an apparatus including a rotatable workpiece holder with electrodes having a first portion mounted to the workpiece holder and a second portion projecting from the first portion upwardly toward a processing plane such that the electrodes only contact a plating surface of the workpiece.

Additionally, the undersigned also contends that modifying Schuster to have electrical contacts that contact the perimeter of the plating surface of the workpiece instead of the backside of the wafer as taught by Schuster would likely alter the efficacy

of the reactor disclosed in Schuster for plating metallized bumps. Schuster teaches using a backside contact on the wafer to selectively plate only onto the top of the metal terminal regions 19 across the surface of the wafer. If Schuster were modified to have electrodes as claimed, this would require the wafer to have a conductive layer under the oxide layer. As a result, the holes 18 in the oxide layer 38 (Figure 3A of Schuster) would need to be formed in a manner that does not damage such a conductive layer, and it appears that both the conductive layer and the oxide layer would need to be etched back to electrically isolate the terminals 19 after plating. Modifying Schuster's reactor to have the claimed front side electrodes would accordingly appear significantly impact the other pre-plating and post-plating procedures for forming the metal bumps on the diode terminals sought by Schuster. Thus, when Schuster is taken as a whole, there is no suggestion to combine Thompson and Ishida with Schuster to come up with the features set forth in claim 40.

Claim 40 is accordingly patentable over the combination of Schuster, Thompson and Ishida. Claims 56, 58, 59, 64 and 65 are accordingly patentable over this combination of references as depending from claim 40, and also because these dependent claims include additional subject matter.

4. The Combination of Bacon, Thompson and Ishida Also Fails to Disclose or Suggest, *inter alia*, a Rotatable Workpiece Holder With Electrodes Having a First Portion Mounted to the Workpiece Holder and a Second Portion Projecting From the First Portion Upwardly Toward a Processing Plane Such That the Electrodes Only Contact a Plating Surface of the Workpiece

Claim 40 is also patentable over the combination of Bacon, Thompson and Ishida. Bacon discloses an electroplating apparatus having a backside wafer contact 73 mounted in a non-rotating lid 38 to provide an electrical connection to the metallized backside of a wafer. (Column 4, lines 4-9 and 49-52.) Bacon also discloses using such an electroplating apparatus to electroplate metal in contact windows so that the metal builds up to a predetermined desired height above the surface of the wafer to form contacts on a diode chip. (Column 5, lines 41-44.) Bacon, accordingly, teaches the

desirability of using a non-rotating lid with a backside electrical contact to form metal bumps on diode chips in a manner similar to Schuster.

Amended claim 40 is patentable over the combination of Bacon, Thompson and Ishida because this combination of references fails to disclose or suggest several features of claim 40. For example, this combination of references fails to disclose or suggest a "rotatable" workpiece holder with "electrodes having first portions mounted to the workpiece holder and second portions projecting from the first portions upwardly toward the processing plane such that the second portions have tips that bear against a peripheral region of the plating surface of the workpiece." First, Bacon merely discloses a non-rotating lid with a backside contact that engages the backside of the wafer instead of a "rotatable" workpiece holder with electrodes that contact only the "plating surface" as set forth in claim 40. Second, Ishida discloses electrodes that are fixed to the tank so that they can pierce a layer of resist as opposed to being mounted to the workpiece holder as set forth in claim 40. As such, neither Bacon nor Ishida discloses a rotatable workpiece holder with electrodes having a first portion mounted to the workpiece holder and a second portion projecting from the first portion upwardly toward a processing plane such that the electrodes only contact a plating surface of the workpiece. Thus, the combination of Bacon, Thompson and Ishida does not disclose or suggest at least one feature of claim 40.

Amended claim 40 is further patentable because any attempt to combine Thompson and Ishida with Bacon to come up with the claimed combination of elements set forth in amended claim 40 would necessarily be based on impermissible hindsight reasoning. The claimed invention in the present case is not obvious over the references because there is nothing in the references to suggest that an improvement in plating into trenches or other small features using a seed layer on the plating surface might be achieved by combining their teachings. Moreover, there is nothing in the references to suggest that the improvement achieved by the combination of a rotatable workpiece holder with electrodes having first portions mounted to the workpiece holder and second portions projecting from the first portions upwardly toward a processing plane such that

the electrodes only contact a plating surface of the workpiece might be achieved by combining their teachings.

In the present case, the problems addressed by the Bacon reference are different than the problems addressed by (a) the Thompson and Ishida references and (b) the present invention. More specifically, Bacon is directed toward depositing contact material in preselected anode regions of diode-coupled surface regions using a plating chamber in which a plating electrode and a deplating electrode are positioned. The two electrodes in Bacon are spaced apart from each other and the workpiece, and Bacon focuses on switching between the electrodes to plate/deplate during a plating cycle. Bacon also teaches agitating the electrolyte using high rate streams flowing up through the electro-reaction cell. There is no suggestion to use a rotating wafer support in Bacon because any advantage of rotating the wafer in combination with Bacon's plating/deplating switching is not disclosed. Moreover, Bacon already discloses agitating the electrolyte by pumping streams of electrolyte toward workpiece at a high rate, so rotation may not add anything to Bacon. There is also no suggestion to use the contacts of Ishida with anything other than a fixed lid because Ishida's contacts are fixed to the tank and rotating the workpiece with a rotatable head would scrape the workpiece across the fixed needle-like contacts of Ishida in a manner that would likely damage both the contacts and the workpiece. Therefore, when taken as a whole, there is no suggestion to combine Thompson and Ishida with Bacon to come up with an apparatus including a rotatable workpiece holder with electrodes having a first portion mounted to the workpiece holder and a second portion projecting from the first portion upwardly toward a processing plane such that the electrodes only contact a plating surface of the workpiece.

Additionally, modifying Bacon to have electrical contacts that contact the perimeter of the plating surface of the workpiece instead of the backside of the wafer as taught by Bacon would likely alter the efficacy of the reactor disclosed in Bacon for plating metallized bumps on diodes. As with Schuster, Bacon teaches using a backside contact on the wafer to plate onto specific regions of the wafer. If Bacon were modified

to have front side contacts as claimed, this would also require the wafer in Bacon to have a conductive layer on the front side instead of the backside of the workpiece. Modifying Bacon's reactor to have the claimed front side contacts would accordingly appear to significantly impact the other pre-plating and post-plating procedures to form the metal bumps on the diode terminals sought by Bacon. Thus, when Bacon is taken as a whole, there is no suggestion to combine Thompson and Ishida with Bacon to come up with the features set forth in claim 40.

Based on the foregoing, claim 40 is accordingly patentable over the combination of Bacon, Thompson and Ishida. Claims 56, 58, 59, 64 and 65 are patentable over the combination of Bacon, Thompson and Ishida as depending from independent claim 40, and also because these dependent claims include additional subject matter. Therefore, the rejection of claims 40, 56, 58, 59, 64 and 65 over the combination of Bacon, Thompson and Ishida should be withdrawn.

5. Claim 66 is Patentable Over Either Schuster or Bacon in Combination With Thompson and Ishida

Claim 66 is patentable over either Schuster or Bacon in combination with Thompson and Ishida. Although claim 66 is different than claim 40 in several respects, claim 66 includes analogous subject matter that is germane to these rejections. As such, claim 66 is patentable over the cited combinations of references for the reasons explained above with respect to claim 40. Claims 67, 69 and 75 are patentable over the combinations of Schuster, Bacon, Thompson and Ishida as depending from independent claim 66 and also because of the additional features recited in these dependent claims. Therefore, the rejections of claims 66, 67, 69 and 75 under Section 103 should also be withdrawn.

C. Section 103 Rejection—Schuster or Bacon with Thompson, Ishida and Yee

Claims 57 and 68 were rejected over either the combination of (a) Schuster, Thompson, Ishida and Yee or (b) Bacon, Thomson, Ishida and Yee. Claims 57 and 68 have been cancelled, and thus this rejection of these claims is now moot.

D. Newly Cited Art

Based upon the current claims, an Information Disclosure Statement is filed concurrently with this amendment to cite drawings for a plating tool that was delivered to IBM under a non-confidential relationship more than one year before the filing date of the present application (the "IBM Tool"). As shown in the drawings entitled "PLATING CELL, 125 mm CERAMIC," the IBM Tool included a rotating head having electrical contacts that depend downwardly from the rotating head. As shown in Sheet 2 of Drawing No. 210T0008, the electrical contacts can (a) pivot outwardly along a radius under the action of an articulating arm to receive a workpiece and (b) pivot inwardly to engage the perimeter edge of the workpiece. Referring to Drawing No. 213T0033, Sheet 1 of this drawing discloses the mounts for the plating fingers and the shape of the plating fingers. Additionally, Drawing No. 213T0032 illustrates additional aspects of the plating fingers. Referring to Sheet 1 of Drawing No. 213T0032 and Sheet 1 of Drawing No. 213T0033, the mounts for the plating fingers pivot the plating fingers outward to receive a wafer and then pivot the plating fingers inward. As the fingers pivot inward, the inclined portion on the shaft of the fingers engages the peripheral edge of the workpiece to center the workpiece such that the vertical portion in the notch of the fingers engages the peripheral edge of the workpiece. The lateral portion of the fingers projects at a right angle to the vertical position so that a ridge on the lateral portion contacts the plating surface of the workpiece. Referring to the drawing entitled "Fluid Flow-Equinox Cu Plating Tool," the drawing to the left is a flow diagram that shows the fluid flow through the chamber in which a workpiece holder has fingers that engage the peripheral edge of the workpiece.

Independent claims 40 and 66 are patentable over the IBM Tool because this reference fails to disclose several features of claims 40 and 66. For example, the IBM tool does not disclose the combination of a rotatable workpiece holder having electrodes with first portions mounted to the workpiece holder and second portions projecting from the workpiece holder upwardly toward the processing plane such that (a) the second portions have tips that bear against a peripheral region of the plating surface of the workpiece, and (b) the first and second portions are spaced apart from

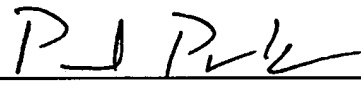
the peripheral edge of the workpiece such that the electrodes only contact the plating surface of the workpiece. Therefore, independent claims 40 and 66 are also patentable over the IBM tool.

E. Conclusion

In view of the foregoing, the pending claims comply with 35 U.S.C. § 112 and are patentable over the cited art. The applicants accordingly request reconsideration of the application and a Notice of Allowance. If the Examiner has any questions or believes a telephone conference would expedite prosecution of this application, the Examiner is encouraged to call the undersigned representative at (206) 359-3258.

Respectfully submitted,
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